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FLUSHING AND OTHER MEANS OF INCREASING LAMB YIELDS.[1]

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EXTENT TO WHICH FLUSHING IS PRACTICED IN THE UNITED STATES.

THE BELIEF that extra feeding of ewes at the time they were bred would result in larger yields of lambs has long been held by students of sheep husbandry. Feeding for this purpose is commonly called "flushing." Though flushing has been practiced by a few breeders of purebred sheep, it has not been generally or seriously considered by flock owners producing market lambs. Practically no figures or results of experiments have been obtainable as to the extent of increase in the lamb crop that could be obtained by flushing the ewes.

This bulletin presents the results of six years' experiments in flushing ewes, covering a total of 352 matings. These experiments were conducted on that portion of the Bureau of Animal Industry farm at Beltsville, Md., known as "Sheep Acres," and at the United States Morgan Horse Farm, Middlebury, Vt. There is added a discussion of other matters to be considered in endeavoring to obtain maximum yields of lambs.

[1] R. B. Millin, now of the Montana Agricultural College, assisted in the early development of the experiments reported in this bulletin.

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FACTORS INFLUENCING SIZE OF LAMB CROP.

The size of the lamb crop is dependent upon two things—the number of dry ewes (those not having lambs) and the number of twins and triplets. Under ordinary farm-flock conditions the proportion of dry ewes is insignificant. In range flocks, however, it is a principal cause of lower lamb yields, and it is often impossible to furnish the feed necessary to put the ewes into condition to make sure of their getting in lamb.

The advantages of flushing are to be obtained principally through an increased number of twins. It has not been proved that the sire influences the number of twins occurring among his offspring. The production of twins or triplets is determined chiefly, if not entirely, by the ewe. Twins may result in either of two ways. First, two developed ova (eggs) may be discharged from the ovaries during the period of heat. Second, a single fertilized ovum may become divided at an early stage and each part develop a fetus. The first is believed to be the more common cause of twins. The production of a second or third ovum is thought to be largely influenced by the condition of the ewe and on this basis the connection between flushing and twin births is rendered very clear.

To show the connection between production of twin lambs and maturing of extra ova, Marshall [2] slaughtered 55 Black-faced Highland sheep shortly after breeding and examined the ovaries to learn the number of ova that were produced. His findings were as follows:

1 ruptured follicle in one ovary—1 ovum produced	42 cases.
1 ruptured follicle in each ovary—2 ova produced	7 cases.
2 ruptured follicles in one ovary—2 ova produced	5 cases.
2 ruptured follicles in one ovary and one in the other—3 ova produced	1 case.

In this case if the ewes had been kept and if all the ova had been fertilized and all developed normally, the result would have been 42 single lambs, 12 pairs of twins, and one set of triplets, a total lamb crop equal to 125.4 per cent of the number of ewes bred. The report of this experiment states that this is higher than the ordinary returns from flocks of the breed and that apparently under ordinary conditions some of the ova do not produce lambs.

It is a common observation that the twin lambs in a flock are produced chiefly in the early part of the lambing season. In 332 cases of lambing in purebred Southdown ewes used in experiments conducted by the Bureau of Animal Industry and extending over six years, 70 per cent of the ewes dropping twins lambed during the first half of the lambing period.[3]

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[2] The Œstrous Cycle and the Formation of Corpus Lutem in Sheep. In Philosophical Transactions of the Royal Society, Series B, No. 196.

[3] In 1920 and 1921 a portion in each lot did not receive the same treatment as the others and, therefore, was not included.

The explanation of these facts must be found in one of two things, either of which has an important relation to management for maximum lamb yields: (1) The ewes that are in the best nourished condition and therefore more likely to produce two ova are also those first to come in heat and get in lamb, or (2) the feed and pasturage are more nutritious early in the season and cause production of more ova by the ewes bred at that time.

In the Bureau of Animal Industry experiments the use of rams began about September 7 to September 10, but in most cases only one or two ewes were bred during the first 10 days. It therefore seems that the ewes ordinarily bred first are those that, owing to their better physical condition, first come in heat at the beginning of the breeding season, and that their condition is at once the cause of their showing heat earlier and producing twins.

An overfat condition may derange the normal action of the ovaries even more seriously than a thin condition. It seldom occurs except in stock fitted for show or in ewes that have missed getting in lamb and grown fat while running dry. In our experiments there have been some rather fat dry ewes which got in lamb as readily as other ewes. They were not allowed grain, however, and had plenty of exercise.

RESULTS OF EXPERIMENTS IN FLUSHING EWES.

GENERAL PLAN OF THE EXPERIMENTS.

The experiments were made with purebred Southdown ewes, all of which had been bred in the Bureau of Animal Industry flocks. The number of animals was 352, divided into 20 lots, of which Lots 1, 2, 5, and 6 were at the Morgan Horse Farm, Middlebury, Vt., and Lots 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 were at the bureau farm (Sheep Acres), Beltsville, Md. The ewes were usually in good condition compared with general farm flocks, which it is thought would tend to lessen the effect of flushing.

In all the tests the lots of ewes were divided with careful regard to age, number of lambs dropped in previous years, gain in weight prior to experiment, and the rams to which bred. As it was necessary to use a number of different rams in each flock, hand breeding [4] was followed, which with the use of teasers [5] made it possible to record the date of each service and at the same time mate each ewe to the ram desired. Approximately the same number of ewes in each lot were bred to each of the rams used that season. In one case the proportion was disturbed because one of the rams was not a sure breeder and some of the ewes booked to him did not get in lamb.

[4] "Hand breeding" is a term applied to the individual mating of a ram and ewe outside the flock.

[5] "Teaser" applies to a ram used in a flock for the purpose of indicating the ewes which are in heat Copulation is prevented by an apron tied around the ram's body.

Such cases were eliminated from the experiment. The data given, are in all cases for ewes having lambs. The matter of dry ewes and the influence of rams upon the lamb yield are discussed separately.

The amount of grain fed was never less than one-half pound per ewe daily; in a few cases it was as much as three-fourths of a pound. The grain mixture used is given in footnotes of Table 1. The gains shown are the averages for each lot, each ewe's gain covering a period averaging 10 days prior to the dates the rams were first used up to the date of the service to which she lambed.

It was planned to hold the unflushed lots without making any gains in weight during the breeding season. Except in the case of Lots 11 14, 17, and 20, the pasturage was the same for the flushed and unflushed lots. There was considerable irregularity in the gains of individual ewes. Some of those in the unflushed lots made quite large gains, while some in the flushed lots made little or no gain. However, the fact of having grain feed may be considered to result in a more highly nourished body condition, even if not reflected in gains in weight.

In all the Vermont flock tests all lots were run on blue-grass pastures. All the flushed lots in the Maryland flock were grazed on forage crops, soybeans being chiefly used during the breeding season. Lots 11, 14, 17, and 20 were pastured on native grass.

NUMBER OF LAMBS DROPPED.

The 8 lots of unflushed ewes for which results are reported here produced lambs at the rate of 128.7 per 100 ewes, while the 12 lots of flushed ewes produced lambs at the rate of 147.4 per 100 ewes, showing an increase of 18.7 lambs per 100 ewes as a result of flushing.

This figure applies to 352 lambings of 157 different ewes used in the fall breeding seasons of 1916 to 1921, inclusive, and includes the total number of lambs dropped, living or dead.

As shown in Table 1, the smallest result obtained from flushing in any one of the separate trials was indicated by a difference in lambing rate which would have resulted in 3.2 more lambs per 100 ewes. This was in the case of Lots 5 and 6, bred at the Morgan Horse Farm, Middlebury, Vt., in the fall of 1917. Both lots of ewes were in very good condition and ran on similar grass pastures. Although fed grain (14 parts, by weight, of corn, 5 parts bran, 1 part linseed meal) at the rate of one-half pound each daily, the flushed lot made an average gain of only 6.3 pounds per head from September 8 until they were in lamb, while in the corresponding time the ewes not fed grain gained 4.58 pounds per head. The most pronounced effects of flushing are seen by comparing Lot 3 with Lot 4, Lot 9 with Lots 10 and 11, and Lot 18 with Lots 19 and 20.

In the case of Lots 3 and 4, both of which were in quite low condition when breeding commenced, there was an average increased gain of 12.38 pounds in weight over the unflushed lot and an increase in lambing at the rate of 30 lambs per 100 ewes in the number of lambs dropped by the flushed lot.

In the second instance the unflushed Lot 9 gained an average of 3.03 pounds per head, while flushed Lot 10, receiving grain, gained an average of 12.25 pounds per head and Lot 11 (pasture flushed) gained 11.86 pounds per head. The unflushed lot produced lambs at the rate of 120 per 100 ewes, while the grain-flushed lot produced lambs at the rate of 150 per 100 ewes and the pasture-flushed lot produced lambs at the rate of 145.5 per 100 ewes.

In the third instance Lot 18 gained 1.55 pounds per head and produced lambs at the rate of 122.2 per 100 ewes. Lot 19 (grain flushed) gained 3.37 pounds and produced lambs at the rate of 147.4 per 100 ewes, and Lot 20 (pasture flushed) gained 8.15 pounds per head and produced lambs at the rate of 169.2 lambs per 100 ewes.

TABLE 1.—*Effect of flushing on yield of lambs from Southdown ewes.*[1]

Lot No.	Number in lot.	Feed given.	Date breeding began.	Average net gain or loss (—) in weight.[2]	Average date of first service.[3]	Average date of conception.[4]	Rate of lambs dropped per 100 ewes.
				Pounds.			*Per ct.*
1	15	Unflushed	Sept. 9, 1916	2.20	Sept. 28	Oct. 8	133.3
2	25	Flushed (grain)[5]	do	4.28	Sept. 27	Oct. 17	140.0
3	10	Unflushed	Sept. 1, 1916	4.75	Oct. 2	Nov. 2	110.0
4	15	Flushed (grain)[6]	do	17.13	Sept. 25	Oct. 24	140.0
5	19	Unflushed	Sept. 10, 1917	4.58	Sept. 28	Oct. 11	136.8
6	20	Flushed (grain)[6]	do	6.30	do	Oct. 10	140.0
7	17	Unflushed	do	1.03	Sept. 21	do	129.4
8	13	Flushed (grain)[6]	do	2.85	Sept. 24	Oct. 8	146.2
9	15	Unflushed	Sept. 10, 1918	3.03	Oct. 4	Oct. 5	120.0
10	14	Flushed (grain)[7]	do	12.25	Oct. 1	Oct. 6	150.0
11	11	Flushed (extra pasture)	do	11.86	Oct. 2	Oct. 14	145.5
12	25	Unflushed	Sept. 10, 1919	—0.74	Sept. 28	Oct. 9	136.0
13	21	Flushed (grain)[8]	do	10.71	Sept. 30	Oct. 20	147.6
14	21	Flushed (extra pasture)	do	3.76	Sept. 25	Oct. 7	152.4
15	24	Unflushed	Sept. 10, 1920	—2.00	Sept. 24	Oct. 4	129.2
16	20	Flushed (grain)[8]	do	5.80	do	Oct. 3	150.0
17	17	Flushed (extra pasture)	do	10.00	Sept. 28	Oct. 9	147.1
18	18	Unflushed	Sept. 12, 1921	1.55	Sept. 29	Oct. 13	122.2
19	19	Flushed (grain)[9]	do	3.37	Sept. 28	Oct. 12	147.4
20	13	Flushed (extra pasture)	do	8.15	Sept. 30	Oct. 13	169.2
All unflushed lots	143	Unflushed		1.34	Sept. 27	Oct. 9	128.7
All flushed lots	209	Flushed		7.60	do	Oct. 12	147.4

[1] This table includes only ewes dropping lambs. The small number of ewes not getting in lamb in no case appeared to be due either to flushing or not being flushed.

[2] From date flushing started to date of conception.

[3] The dates of first service show the effect of flushing upon bringing ewes into heat earlier.

[4] The date of conception is considered to be the recorded date of service nearest to 147 days prior to lambing.

[5] Flushing grain consisted of equal parts corn and oats, by weight.

[6] Flushing grain consisted of 14 parts corn, 5 parts bran, 1 part linseed meal, by weight.

[7] Flushing grain consisted of oats.

[8] Flushing grain consisted of 4 parts corn, 4 parts oats, 2 parts bran, 1 part linseed meal, by weight.

[9] Flushing grain consisted of 10 parts corn, 5 parts oats, 5 parts bran, 2 parts linseed meal, by weight.

Breeds having a larger proportion of twin births than the Southdowns can be expected to give larger returns from flushing. Also, most farm ewes should show larger increases in lamb yields as a result of flushing than were obtained in these experiments because of the fact that ordinarily they are thinner at the time of breeding.

RELATION OF WEIGHT GAINS TO NUMBER OF TWINS.

Individual weights of the ewes were kept, and these permit an analysis of the relation between actual gains and numbers of twins produced.

Of 57 cases in which ewes lost from 1 to 7 pounds during the breedings season, twins were produced by 21, or 37 per cent.

Of 178 cases in which ewes gained up to 7 pounds during the breeding season, twins were produced by 60, or 34 per cent.

Of 117 cases in which ewes gained 7 to 30 pounds during the breeding season, twins were produced by 57, or 49 per cent.

These results suggest that in order to produce the largest number of twins, ewes should gain 7 pounds or more.

FEED FOR FLUSHING.

With a view of determining the kinds of feed most efficient and most economical for use in flushing, the flock at Beltsville was divided into three lots in 1918, 1919, 1920, and 1921. One lot in each year was unflushed while the other two were flushed. One of the flushed lots was fed grain in each case while the other was kept on extra good pasture. In 1918 the grain-flushed lot, No. 10, gaining an average of 12.25 pounds per head, produced lambs at the rate of 4.5 more per 100 ewes than Lot 11, pasture flushed, which gained 11.86 pounds.

In 1919, Lot 14, given extra pasture and gaining 3.76 pounds, produced lambs at a rate af 4.8 more per 100 ewes than Lot 13, which was flushed with grain and gained 10.71 pounds.

In 1920, Lot 16, flushed with grain and gaining 5.8 pounds, produced at a rate of 3 more lambs per 100 ewes than those flushed with extra pasture and gaining 10 pounds, while in 1921, Lot 20, flushed with extra pasture and gaining 8.15 pounds, produced 21.8 more lambs per 100 ewes than Lot 19, flushed with grain and gaining 3.37 pounds per head. No other lots show so large a variation due to the different methods of flushing. Lot 20 has also the highest lambing percentage of all the lots.

The fact that in two of the four cases the grain-flushed lots produced the highest lambing percentage, however, would indicate that there is no decided advantage in the kind of feed used in flushing except that where pasture flushing is practiced there is the saving in labor and more expensive grain feed. There are times, however,

owing to unfavorable weather, when good pasture is not available and pastures are too short even to hold ewes at their initial weight. In such cases grain could no doubt be economically used.

EARLINESS OF LAMBING.

In addition to the increase in the number of lambs from flushed ewes, many breeders have believed that the extra nourishment brought the ewes in heat earlier, thereby resulting in earlier lambs. These tests, however, do not bear out that belief, the average date of first service being the same for both flushed and unflushed lots.

UNIFORMITY OF LAMBS' AGES.

Having all the lambs of about the same age is a great advantage in marketing and flock management. It was thought that flushing would bring the ewes to service earlier, and thus be a great aid in preventing late lambs. This expectation was not realized, however, in the experiments. More of the cases of not getting in lamb until the second or third service occurred among the flushed ewes and was of course followed by a larger proportion of late lambs.

The number of ewes lambing to each successive service in each year is shown in the following table; 20 ewes which were bred after being interchanged between lots on a special test are not included.

TABLE 2.—*Number and per cent of ewes getting in lamb at each service.*

Year.	Unflushed lots.							Flushed lots.						
	Lot No.	Ewes in lot.	Service.					Lot No.	Ewes in lot.	Service.				
			1st.	2d.	3d.	4th.	5th.			1st.	2d.	3d.	4th.	5th.
1916	1	15	8	5	2	0	0	2	25	10	10	3	1	1
	3	10	0	4	5	1	0	4	15	7	7	1	0	0
1917	5	19	15	3	1	0	0	6	20	15	3	2	0	0
	7	17	7	4	5	1	0	8	13	6	3	3	1	0
1918	9	15	14	1	0	0	0	10	14	11	3	0	0	0
								11	11	7	2	1	1	0
1919	12	25	13	9	2	1	0	13	21	6	7	6	2	0
								14	21	12	3	6	0	0
1920	15	18	12	6	0	0	0	16	16	12	4	0	0	0
								17	14	9	4	1	0	0
1921	18	12	8	3	0	1	0	19	16	10	3	1	2	0
								20	15	7	5	3	0	0
Total		131	77	35	15	4	0		201	112	54	27	7	1
Percent			59	27	11	3				56	27	13	4	0

TWIN PRODUCTION AS AFFECTED BY AGE OF EWE.

Flock records of the Bureau of Animal Industry show a gradual rise in the proportion of twins born until the ewes are 5 and 6 years old.[6] There is a possibility that this is due in part to elimination of

[6] These records are in substantial agreement with data obtained from the University of Wisconsin flock which showed a gradual increase in per cent of lambs produced by ewes until 5 years of age. See "The Relation of Age of Dam to Observed Fecundity in Domesticated Animals. I. Multiple Births in Cattle and Sheep," by Sarah V. H. Jones and James E. Rouse, in Journal of Dairy Science, Vol. III, No. 4, July, 1920.

ewes not dropping twins. In our experimental flocks, however, ewes have never been discarded on that account, although some ewes have been kept to advanced age that might have been disposed of one or two seasons earlier if it had not been for their marked prolificacy. The figures given in Table 3 for ewes over 6 years old may, therefore, have been to a slight extent affected by selection. The data given include nine years' records. The ages are those at time of lambing and not at time bred. Only ewes producing lambs are included in this table.

TABLE 3.—*Effect of age of ewes on number of lambs dropped in experimental flocks.*

Age of ewes.	Cases of lambing.	Number of lambs dropped.	Age of ewes.	Cases of lambing.	Number of lambs dropped.
Years.		*Per 100 ewes.*	*Years.*		*Per 100 ewes.*
2	79	111.4	6	49	161.2
3	63	123.8	7	35	142.8
4	67	143.3	8	22	113.6
5	62	143.5	9	8	162.5

TWIN PRODUCTION AS AFFECTED BY BREED OF EWE.

Evidence as to inheritance of fertility makes it appear that various breeds or strains have each an inherited limit of fertility and that the obtaining of the full possibility in any one season will be determined by the extent to which the conditions and management favor the full utilization of the inherited capacity.

Records of actual returns from 189 flocks representing 9 breeds for the seasons of 1919 and 1920 were obtained by the Animal Husbandry Division through the kindness of breeders who reported. The average number of lambs in proportion to ewes, lambing in the spring, is shown below, also the separate record of the 2-year-old ewes dropping lambs the first time) and the highest flock average reported for each breed. The table gives the average of the two seasons' reports. The high return for the breed is for a single season.

TABLE 4.—*Record of lamb crops, by breeds, from 189 flocks.*

[Average of seasons 1919 and 1920.]

Breed.	Flocks.	2-year-old ewes.		Aged ewes.		Total ewes.		Highest flock.	
		Ewes.	Number of lambs dropped.	Ewes.	Number of lambs dropped.	Ewes.	Number of lambs dropped.	Ewes.	Number of lambs dropped.
	Number.	*Number.*	*Per 100 ewes.*	*Number.*	*Per 100 ewes.*	*Number.*	*Per 100 ewes.*	*Number.*	*Per 100 ewes.*
Dorset	26	215	146	566	163	781	158	6	200
Lincoln	11	40	145	106	161	146	157	11	191
Oxford	18	96	144	214	156	310	152	6	200
Southdown	27	138	143	378	153	516	151	6	200
Hampshire	26	549	139	857	148	1,406	144	6	200
Cotswold	16	91	135	190	148	281	144	23	200
Shropshire	25	167	134	402	154	569	148	6	183
Tunis	16	84	123	184	149	268	141	8	200
Rambouillet	24	186	111	667	125	853	122	9	177

TWIN PRODUCTION AS AFFECTED BY SIRE.

A study of 334 cases of lambing from the services of 5 rams, none of which were used less than three seasons nor on less than 20 ewes, does not indicate any important variation in proportions of twins that can be attributed to the sire. Such differences as were shown in the average number of lambs per service for each sire appeared to be due to differences in the ewes to which they were bred. Records of 380 lambings from services of 8 different sires were studied in relation to the ages of the rams at the time of service. The results did not show any connection between age of sire and number of twins among his "get."

Overworked or run-down condition of a ram may result in a smaller lamb crop through a lack of numbers or of vitality of the sperm cells in the seminal fluid. Such a lack is most likely to occur in the case of ram lambs running in a flock with the ewes, and it would be more likely to result in ewes not getting in lamb than in a decreased number of twins. Though improbable, it is possible that a ewe might produce two ova and have one of them fail to become fertilized because of a lack in the number or vitality of the sperm cells.

BREEDING FOR TWIN LAMBS.

It appears quite logical to suppose that the proportion of twin births in a flock can be increased by selecting, for breeders, rams and ewes themselves born as twins. However, our records do not bear out such a supposition. This does not preclude the possibility of increasing lamb yields by breeding, but selection for this purpose should be based on average yields of different strains rather than on records of individuals.

The fact that a ram was born as a single or as a twin can not reasonably be expected to have any relation to the number of twins among his offspring. The function of the sperm cells of the male is to fertilize the ova produced by the female, and under ordinary conditions the number and strength of the sperm cells is many times greater than actually needed.

It is reasonable, however, to expect a son of a ewe that is a regular producer of twins to transmit some or all of his dam's capacity to his daughters. Any ewe's inheritance of capacity for bearing twins must therefore be traced through the prolificacy records of her female ancestors.

In the breeding of the bureau's purebred Southdown flock, records have been obtained of 458 cases of lambing which include only ewes that have dropped lambs at least three times. A few of the ewes had eight or nine lambing records. The relation of the production of these ewes, the fact of their having been born as singles or twin

lambs, and also whether their sires and dams were born as singles or twins are shown in Table 5. It must be remembered that the fact of a ram or a ewe having been born as a single or twin is in itself an incomplete record of the dam's productive capacity.

As shown in the table twin-born ewes were found to have produced lambs at a rate of 4.7 more per 100 ewes than those born singles. The highest record, however, is from ewes born as singles with both parents twins, and the second highest record is for single-born ewes by single sires from twin dams.

The number of cases considered is so limited in this table that results might vary greatly with additional data in regard to the influence of grandparents upon number of lambs produced per 100 ewes. There does not appear to be any connection of practical value between lamb production and the fact of sires and dams having been singles or twins.

TABLE 5.—*Effect of breeding on twin production of Southdown ewes in Government flock.*[1]

Ewes' breeding.	Number of ewes.	Number of lambings.	Number of lambs dropped.[1]
			Per 100 ewes.
Born twins:			
Sires twins, dams twins	3	12	133
Sires singles, dams twins	18	84	142.9
Sires twins, dams singles	3	12	116.6
Sires singles, dams singles	27	134	142.5
Average for twin ewes			140.9
Born singles:			
Sires twins, dams twins	4	14	157.1
Sires singles, dams twins	12	70	145.7
Sires twins, dams singles	4	21	109.5
Sires singles, dams singles	24	111	132.7
Average for single ewes			136.2

[1] In a study of more than 10,000 sheep taken from the American Shropshire Sheep Record, Rietz and Roberts found twin ewes to have produced 144.1 lambs per 100 ewes, while singles produced 135.9 lambs per 100 ewes. These data were obtained from flocks of variable management, however, which might in itself tend to make for correlation between successive generations in numbers produced at a birth. See "Degree of Resemblance of Parents to Offspring, with Respect to Birth as Twins for Registered Shropshire Sheep," in Journal of Agricultural Research, Vol. IV, No. 6, Sept. 15, 1915.

A safer way of appraising the possibility of increasing twin production by selection is to take into account the full records of female ancestors rather than a single birth in which the particular sire or particular dam was produced.

VALUE OF TWIN LAMBS IN COMPARISON WITH SINGLES.

Sheep raisers differ in their ideas of the desirable size of the lamb crop. At one extreme are ranchmen, chiefly interested in wool production, who consider twins as undesirable because feed conditions are unfavorable to a ewe's furnishing more than sufficient milk for one lamb. Even in such cases, however, it is always likely that a

number of ewes will lose their lambs and a corresponding number of pairs of twins would allow transferring one from each pair of twins to a ewe in milk and without a lamb. This would render possible the rearing of 100 per cent of lambs.

There are, also, a few breeders of registered sheep who believe that there is no gain in obtaining twin lambs. Their position is based upon the fact that some twin lambs do not develop so fully as singles. Since a good individual animal sold for breeding purposes may bring as much as or more than two inferior ones, single lambs might be an advantage, provided they always proved more valuable at selling age.

At the other extreme are raisers of market lambs in whose hands a pair of twins, even though comparatively underdeveloped and sold perhaps at a lower price per pound, still will bring a much larger amount than the single lamb.

With ewes lambing for the first time, it is less desirable to have twin lambs than with older ewes. Young ewes do not ordinarily milk so well nor look after their lambs so faithfully, and thus they have a greater rate of loss in twin lambs than older ewes. In most flocks, if not all, containing the ordinary proportion of ewes of varying ages, the mark can well be set at 150 per cent of lambs in working for the greatest net returns.

Possible disadvantages in twin lambs must come from one or all of three causes: (1) Greater rate of loss among twins; (2) slower rate of growth as lambs; or (3) inability to reach the same size, weight, and breeding value as single lambs.

As regards the rate of loss, the experience of the Bureau of Animal Industry shows no greater losses among twins. In the lambing seasons of 1916 to 1920, inclusive, in the two flocks of Southdowns used in the experiments a total of 224 single lambs and 290 twin lambs was born. Of these, 14.3 per cent of the single-born lambs died before reaching the age of 2 weeks, and 13.4 per cent of the twins.

COMPARATIVE WEIGHTS OF SINGLE AND TWIN LAMBS.

Comparative weights of twins and single lambs at six months old show that the milk received by the lambs is more important in influencing growth than is birth as a single or twin.

Records of 184 lambs dropped through three different years are grouped to show weights attained by both sexes and by single lambs, twin lambs, and lambs born as twins but having all of one ewe's milk (twins raised as singles). The weights of the ram lambs include 3 or 4 wethers.

TABLE 6.—*Weights of 6-months-old twin and single lambs.*

Kind.	Singles.		Twins.		Twins raised as singles.	
	Number.	Average weight.	Number.	Average weight.	Number.	Average weight.
		Pounds.		*Pounds.*		*Pounds.*
Ram lambs	32	85.4	45	81.6	9	82.7
Ewe lambs	46	73.8	37	67.6	15	78.3
All lambs	78	78.6	82	75.3	24	79.9

The twin-born ewe lambs averaged 6 pounds lighter at six months than those born singles, while in the case of ram lambs the difference was 4 pounds. In the smaller groups of twin lambs raised as singles the ewes made an especially good growth, averaging more than the single lambs.

Three experiments were conducted to determine whether twin ewe lambs would catch up in weight with the singles if given an opportunity. Of the 1915 crop, 19 head of singles and 22 twin-ewe lambs were fed separately for 112 days (December 8, 1915, to March 28, 1916). At the outset the singles were 8.6 pounds heavier and at the close of the test they were 11 pounds heavier. They received similar feed, but that eaten by the twins contained about 6 per cent more total energy. After running in the same lot on pasture until August 30, 1916, the single-born lambs were still 8 pounds heavier.

In November, 1916, 8 head of single ewe lambs and 8 head of twins that had been raised as twins were placed in a similar experiment. The average daily ration fed the twins contained 0.28 pound of protein and 1.84 therms of energy as compared with 0.24 pound of protein and 1.57 therms of energy for the singles. At the start the singles were 7 pounds heavier and at the close of the special feeding the weights were identical. The twins were somewhat fatter, however, and after running with the others on pasture until August 25, 1917, were 2.4 pounds lighter.

In the summer of 1917 an attempt was made to furnish lambs raised as twins sufficient extra grain to permit them to catch up with those born singles. From birth (about March 1) until July 1, there were 11 single ewe lambs and 3 born twins but raised as singles in one lot, and 8 twin-raised ewe lambs in the other lot. During that time the former ate 50 pounds of grain each and the twins 63 pounds, with the result that the twin lambs averaged 7 pounds lighter than the others. Subsequently the lambs were fed and pastured as one lot until December 29, 1917, at which time the singles were 3 pounds heavier. From December 29, 1917, to April 6, 1918, the single lambs ate an average daily ration of 1 pound of the following grain mixture: Cracked corn 100 parts, bran 30 parts, in connection with 2 pounds timothy hay and 2 pounds turnips per head. That eaten by

the twin lambs consisted of 1⅜ pounds of a mixture consisting of cracked corn 80 parts, oats 60 parts, bran 35 parts, in connection with 2 pounds of timothy hay and 2 pounds of turnips. On April 6 the singles weighed 107 pounds and the twins 110. That their extra gain was not fat is shown by the fact that after running on pasture with no feed until August 10, the twins were 3.1 pounds heavier per head than the singles. A comparison of the gains made by singles, twins raised as twins, and twins raised as singles, is shown in Table 7.

The fact that lambs born as twins but receiving all of one ewe's milk often equal and sometimes outweigh single lambs makes the matter appear to be one of nourishment. The slight lack of growth and development of twin-ewe lambs below that of singles at market age is not serious in comparison with the advantage of larger numbers.

TABLE 7.—*Gains made by single and twin lambs in bureau flocks at Middlebury, Vt., and Beltsville, Md.*

Sex and flock.	Single lambs.					Twin lambs raised as twins.					Twin lambs raised as singles.				
	No. head.	Average weight.				No. head.	Average weight.				No. head.	Average weight.			
		Birth.	3 mos.	6 mos.	12 mos.		Birth.	3 mos.	6 mos.	12 mos.		Birth.	3 mos.	6 mos.	12 mos.
Middlebury flock:															
1916—Rams	5	9.0	75.6	97.4	130.8	9	9.2	68.2	89.4	131.0	1	7.8	68.0	84.0	109.0
Ewes	8	9.2	64.8	77.9	(1)	10	7.5	55.6	67.9	(1)	8	7.8	65.5	81.1	114.4
1917—Rams	5	7.9	66.8	94.8	117.4	4	7.6	59.5	84.3	108.5	4	7.8	57.5	87.3	118.0
Ewes	11	8.3	61.7	78.8	106.7	8	7.5	55.9	76.5	109.6	3	7.1	67.0	84.3	111.7
1918—Rams	8	8.6	56.4	84.8	121.8	12	7.4	49.8	77.9	117.8	1	7.3	51.0	83.0	119.0
Ewes	13	8.8	54.1	76.8	113.7	11	6.9	38.2	63.8	107.5	2	6.1	41.0	68.5	101.0
Average:															
Rams	18	8.5	64.6	91.1	123.1	25	8.1	58.0	83.1	121.0	6	7.7	58.1	86.0	116.6
Ewes	32	8.7	59.4	77.9	110.5	29	7.3	49.1	68.9	108.4	13	7.4	62.1	79.9	111.7
Beltsville flock:															
1917—Rams	2	8.4	40.5	69.0	96.0	3	6.9	45.2	73.5	94.7	2	6.2	38.8	67.8	91.8
Ewes	8	7.7	42.8	63.6	82.0	3	6.4	39.8	60.8	86.7	1	6.6	55.0	74.0	96.0
1918—Rams	5	8.3	59.9	82.7	109.4	6	7.1	49.1	77.3	119.8	....	.....	.....	.....	.....
Ewes	3	8.2	56.5	69.0	104.7	3	5.8	42.5	68.2	111.7	1	5.7	39.0	61.0	83.0
1919—Rams	9	8.0	54.4	65.1	100.2	5	7.3	45.6	60.6	97.8	4	6.6	55.1	66.3	97.0
Ewes	13	8.1	53.2	66.5	91.2	8	6.6	50.7	64.9	90.3	3	6.7	53.5	68.7	92.7
1920—Rams	7	8.4	60.3	82.0	124.5	14	7.2	51.0	78.9	117.5	1	6.8	40.0	67.0	106.0
Ewes	17	8.3	47.8	64.5	98.8	17	6.5	44.8	64.8	102.3	2	6.9	55.5	70.0	92.0
Average:															
Rams	23	8.2	56.2	74.4	109.2	28	7.2	49.0	74.7	112.0	7	6.5	48.3	66.8	96.8
Ewes	41	8.1	49.2	65.3	93.6	31	6.5	45.6	64.8	98.6	7	6.6	52.2	68.7	91.6
Average:															
All rams	41	8.4	59.9	81.7	115.3	53	7.6	53.2	78.7	116.3	13	7.0	52.8	75.7	105.9
All ewes	73	8.4	53.6	70.9	99.8	60	6.9	47.3	66.7	102.3	20	7.1	58.6	75.9	104.7
All lambs	114	8.4	55.9	74.8	105.8	113	7.2	50.2	72.3	109.5	33	7.1	56.9	75.8	105.2

[1] Placed in special experiment and weight not comparable.

SUMMARY.

The practice of extra feeding at breeding time to increase the number of twins produced by ewes is called "flushing."

The percentage of lambs produced by a flock depends upon the number of dry ewes and the proportion of ewes producing twins and triplets.

The practical advantage of flushing lies in the production of twins, which in turn depends primarily upon the number of ova produced by the ewe.

Experiments here reported indicate that ewes getting in lamb first produce the largest percentage of twins.

The experimental sheep were divided into 20 lots averaging 18 in each lot. Comparisons made with flushed and unflushed lots under varying conditions showed that an average increase of 18.7 lambs per 100 ewes was obtained as a result of flushing.

The most pronounced effect occurred with Lots 18 (unflushed) and 20 (flushed), the latter gaining an average of 8.15 pounds in weight, or 6.6 pounds more than Lot 18, and increasing the number of lambs dropped by 47 per 100 ewes.

The data obtained indicate that in order to produce the largest number of twins, ewes should gain at least 7 pounds a head during the breeding season.

Comparing grain with pasture as best feed for flushing, the work indicates that there is no decided advantage in the kind of feed used other than the saving in labor and expense when sufficient good pasture is available.

The influence of age of the ewe on twin production shows a gradual increase up to 6 years. The rate of lambs dropped by ewes 2 years of age was 111.4 and at 6 years 161.2 per 100 ewes.

The influence of heredity (breed) on twin production is shown by records obtained from breeders of 189 flocks representing 9 breeds. There is little difference among the Dorset, Lincoln, Oxford, and Southdown, these being the 4 highest breeds.

The mating of rams and ewes themselves born as twins does not appear to increase the proportion of births. However, there seems to be some increase in per cent of lambs produced by ewes from heavy twinning strains in a given breed.

There is no material difference in the size of twins and singles when fully developed.

Although at market age twin lambs would not weigh so much as singles, the difference in weight would be small compared to the total weight of the lambs for sale, thus making twins far more profitable.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

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